

Oral Health Care for Children in Countries Using Dental Therapists in Public, School-Based Programs, Contrasted with That of the United States, Using Dentists in a Private Practice Model

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The United States faces a significant problem with access to oral health care, particularly for children. More than 50 countries have developed an alternative dental provider, a dental therapist, practicing in public, school-based programs, to address children's access to care. This delivery model has been demonstrated to improve access to care and oral health outcomes while providing quality care economically.

We summarize elements of a recent major review of the global literature on the use of dental therapists, "A Review of the Global Literature on Dental Therapists: In the Context of the Movement to Add Dental Therapists to the Oral Health Workforce in the United States."

We contrast the success of a school-based model of caring for children by dental therapists with that of the US model of dentists providing care for children in private practices. (*Am J Public Health*. 2013;103:e7–e13. doi:10.2105/AJPH.2013.301251)

THE UNITED STATES' ECO-

nomically disadvantaged children bear a disproportionate burden of dental disease. Although 40 million of the country's 78 million children will be covered by public dental insurance by 2014, they will still suffer neglect because the overwhelming majority of dentists do not provide care for publicly insured children in their practices.¹⁻³

Interest is increasing in expanding the workforce to include the development and deployment of individuals with skills in caring for children traditionally associated with the school dental nurse/dental therapist.⁴⁻⁶ Using school dental nurses/dental therapists originated in New Zealand in 1921.⁷ The New Zealand model has subsequently spread to more than 50 countries.^{8,9} Dental therapists are typically deployed in school-based clinics to ensure access to dental care for all children.

Dental therapists are highly skilled technicians, typically with 2 to 3 years of vocational training that emphasizes technical treatment skills and individual- and community-level prevention programs.⁹ Worldwide, their scope of practice includes examination, diagnosis, and treatment planning; exposing radiographs; oral health education; preventive services such as prophylaxis, fluoride therapy, fissure sealants, and dietary counseling; preparation of cavities

in primary and permanent teeth and restoration with amalgam, composite, and preformed stainless steel crowns; and extraction of primary teeth. They have been successfully serving Native Americans in remote Alaskan villages since 2005.^{5,6} Minnesota authorized the training of dental therapists, with the first class graduating and beginning to care for its underserved populations in 2012.¹⁰ The development of dental therapists is supported by many US public health and philanthropic organizations, including the American Association of Public Health Dentistry¹¹ and the American Public Health Association¹² but opposed by the American Dental Association,¹³ most constituent state dental associations, the American Academy of Pediatric Dentistry,¹⁴ and other dental specialty organizations.

It is possible that some of organized dentistry's opposition to dental therapists is based on inadequate knowledge of their use and acceptance by the public and the dental profession in many other countries. To rectify this circumstance and provide an objective basis for consideration of introducing dental therapists in the United States, the W. K. Kellogg Foundation funded the University of Kentucky to conduct a study of the global literature on the use of dental therapists. The final report, "A Review of the Global Literature

on Dental Therapists: In the Context of the Movement to Add Dental Therapists to the Oral Health Workforce in the United States," was conducted by 17 international dental educators and public health officials and published online in April 2012.⁹ More than 1100 documents from the 54 countries using dental therapists were identified. The 460-page monograph relied heavily on annotations of the literature, mostly direct quotes or excerpts to minimize bias.

We describe oral health outcomes for children participating in international, population-centered, public, school-based programs staffed by dental therapists and contrast them with outcomes from the individual-centered, private-practice model staffed by dentists in the United States. In these programs, dental therapists are supervised by dentists, with their range of services closely restricted to their scope of training and assessed abilities. Supervision is typically indirect, with clinical dentists available for consultation or referral as needed.

QUALITY OF CARE

Extensive studies have been undertaken to evaluate the technical competence of dental therapists when performing restorative and minor surgical procedures.

In 1950, John T. Fulton, the dental services advisor to the US Children's Bureau, studied New Zealand's school dental nurse program for the World Health Organization. He concluded that school dental nurses were capable of placing excellent silver amalgam restorations, 82% of which he judged to be superior.¹⁵ In 1972, a team of dentists from the 2 California dental associations, led by Dale Redig, dean of the University of the Pacific School of Dentistry, determined that more than 97% of the silver amalgam restorations placed were of satisfactory quality and concluded, "There is little doubt that dental treatment needs related to caries for most New Zealand children age 2 1/2 to 15 have been met."¹⁶(p338)

Roder¹⁷ evaluated teeth restored by school dental nurses and dentists in South Australia in 1973. Only 1.8% of dental nurses' restorations were defective, compared with 2.6% of dentists'. In 1983, David Barmes,¹⁸ chief dental officer of the World Health Organization, conducted a review of the School Dental Service in South Australia. The quality of care provided by the school dental nurses was excellent. A 2009 study in Australia¹⁹ evaluated dental therapists' restorations in adults. More than 94% were judged to be successful, a rating as good as that for those placed by dentists.

In 1966, the General Dental Council of the United Kingdom appointed 28 dentists to assess the quality of restorations placed by the New Cross dental auxiliaries (dental therapists); 91% were rated satisfactory.²⁰

In 1972, the Saskatchewan government launched a 2-year training program for dental nurses and therapists in Regina to develop a school-based dental care

program. In 1976, 3 Canadian academic dentists—E. R. Ambrose, dean and former chair of restorative dentistry at McGill University in Montreal; A. B. Hord, chair of restorative dentistry at the University of Toronto; and W. J. Simpson, chair of pediatric dentistry at the University of Alberta—conducted blinded clinical examinations of children in the program who had received care from the newly trained dental therapists as well as from dentists. They were evaluated by the criteria developed by Ryge.²¹ The dental therapists had more restorations rated as superior and fewer rated as unsatisfactory than did the dentists. Additionally, no difference was found in the quality of stainless steel crowns placed by dentists or dental therapists. The concluding summary stated,

Aside from the high standard of treatment services, there is little doubt that the personnel of the Saskatchewan Dental Plan place a good deal of emphasis on the preventive aspects of dental care. . . . There is no question that the children's dental program functioning in Saskatchewan is providing much needed dental care to large numbers of children who otherwise would not be receiving it.²²(p14)

In 1989, the Canadian government requested 2 former presidents of the Canadian Dental Association to assess and evaluate dental treatment provided by dentists and dental therapists practicing among aboriginal populations. Their findings paralleled those of Ambrose et al.,²² with more restorations placed by dental therapists being evaluated as superior and fewer being evaluated as unsatisfactory in comparison with dentists.²³

No comparable studies have been done on the quality of care provided by dentists in the United States. However, studies were

conducted in the United States in the 1970s at the Forsyth Institute,^{24,25} the University of Kentucky,²⁶ and the University of Iowa²⁷ demonstrating the ability of dental hygienists with additional training to provide quality restorative care for children comparable to that of US dentists and dental therapists internationally. In addition, the recent introduction of dental therapists in Alaska has resulted in studies demonstrating that these individuals are providing technically competent dental care that is equal to the level of care provided by a dentist.²⁸⁻³¹

ACCESS TO AND EFFECTIVENESS OF CARE

The impetus for adding dental therapists to the oral health workforce has typically been to improve both access to care and effectiveness of care for children. In most countries, dental therapists are public health employees deployed in school-based dental programs. Global studies have demonstrated high enrollment in school-based programs and improved access to care, essentially for the entire population of elementary school children.

Evaluations of dental services based on the dental health of the population must be seen in the light of falling levels of dental caries (tooth decay) resulting from other factors, such as increased implementation of water fluoridation and increased use of topical application of fluorides, fluoride toothpastes, and fissure sealants. Health promotion and disease prevention programs are a necessary foundation of any successful system of care. Not all dental caries can be prevented; therefore, the proportion of dental caries in children that has been effectively

treated is a strong and reliable indicator of the accessibility and effectiveness of dental care. The epidemiological index measuring the experience of dental caries (tooth decay) is indicated by the number of decayed, missing, and filled teeth. Children's primary teeth are examined for untreated decay (d), filled or treated decay (f), and missing (m) teeth, 3 mutually exclusive categories. Upper-case letters (DMFT) are used when permanent dentition is being evaluated. The positive impact of the school-based delivery model on the effectiveness of care for children is demonstrated by improvement in dmft and DMFT indices, as well as a markedly lower prevalence of untreated decay.

New Zealand

Since its founding in 1921, New Zealand's school dental service, staffed by school dental nurses, now called dental therapists, has provided access to comprehensive dental care for New Zealand's children.^{9,32}

Early longitudinal data established the effectiveness of the school dental service. The ratio of extractions to restorations fell from 73% in 1925 to 3.6% in 1964. In 1960, there were 19 extractions per 100 children versus 407 extractions per 100 children in 1925.³³

In 2003, 97% of children aged 5 to 13 years and 56% of preschool-aged children used the school dental service. Data indicated that 53% of 5-year-old children in New Zealand were caries-free in that year, with a mean mft of 1.8; at ages 12 to 13 years, 42% were caries-free, with a mean MFT of 1.6.³⁴ (The d/D was not included in the epidemiological index because there were essentially no decayed teeth, with

all having been restored or removed during the school year; W. M. Thomson, personal communication, May 2003.)

A national oral health survey in 2009 reported large improvements in the oral health of children since the 1980s. Sixty percent of preschool children and 98% of primary and intermediate school children participated in the school dental service. Of the teeth requiring care, 81.7% had been treated.³⁵ Sixty-eight percent of adolescents used publicly funded dental services provided by private practitioners. The number of caries-free children aged 12 to 13 years had almost doubled between 1988 (28.5%) and 2009 (51.6%). The average DMFT for the group had decreased significantly from 2.4 to 1.3.

Australia

A school dental service using dental therapists was initiated in 1966.³⁶ As a consequence of its more recent introduction, use of school-based dental care for children is not as extensive as in New Zealand, nor is it as integral a component of the culture of dental care. A 2000 study by the Australian Institute of Health and Welfare reported that 62% of children aged 6 to 12 years visited the school dental service the previous year and 38% visited a private practitioner.³⁷

Roder^{17,38} found that secondary school students in the South Australian school dental service had lower decay rates and more restored teeth than did nonparticipants. These students had better oral health knowledge (literacy), better oral hygiene habits, and improved gingival health. He also found that Australian school dental therapists spent 25% to 30% of their time on oral health education.

Canada

Historically, Canada has had 2 dental therapy training programs; neither exists currently. One school trained dental therapists for Saskatchewan's province-wide school-based program.³⁹ The second program focused on training dental therapists to provide care for aboriginal children living in remote northern areas of Canada.⁴⁰

Saskatchewan implemented its school-based dental therapist program in 1974, establishing clinics across the province by the end of the 1st year. Within 3 years, 82% of the elementary school population was enrolled.⁴¹

After 6 years, 76% to 90% of the children had all their treatment needs completed during the school year. The number of restorations, pulpal procedures, and extractions declined each year.⁴²

After 10 years, the dmft for children aged 6 years dropped from 6.5 to 3.4, and by 1988 the dmft of children aged 6 years had further declined to 1.1.⁴³

The impact of school-based dental therapist-staffed programs in Canadian aboriginal communities was studied in 5 different provinces.^{44,45} Over a 10-year period from 1978 to 1988, the restorations-to-extraction ratio steadily increased, indicating dental therapists were reducing the number of extractions and increasing the number of restorations. The ratio of restorative procedures steadily declined relative to an increasing number of preventive therapies, indicating improving levels of oral health in the communities served by dental therapists and the effectiveness of their prevention activities.

Hong Kong

Hong Kong established the School Dental Care Service in 1981, resulting in improved

access to care and a decline in dental caries of Hong Kong schoolchildren.⁴⁶ The participation rate in the program increased from 29% to 65% in 6 years.⁴⁷ By 2011, the participation rate of primary school children reached 95%.⁴⁸

In 1980, just before the establishment of the School Dental Care Service, more than one half (57%) of children aged 9 to 11 years had at least 1 permanent tooth with caries. The mean DMFT was 1.5, and more than 90% of carious teeth were untreated.⁴⁷ In 2001, the mean DMFT of children aged 12 years was 0.8, and 62% of the children had remained caries-free in their permanent dentition. The major component of the DMFT was the filled component, at 0.6.⁴⁹

Singapore

Singapore's School Dental Service began in 1946, after World War II, when it was determined that 98% of all children examined required treatment.⁵⁰ A 2007 Singapore Ministry of Health report stated,

The DMFT index has been improving consistently since the institution of the Singapore Dental Service (SDS). Instrumental in this is the role of the DTs [dental therapists] in the SDS. The oral health status of children has improved most dramatically.⁵¹

By 2009, the dental service's dental therapists had rendered 89% to 96% of elementary school children "dentally fit."⁵² An oral health survey done in 2008 determined the DMFT of children aged 12 years to be 0.7, enabling Singapore to achieve one of the lowest DMFTs in the world.⁵²

Malaysia

By 2003, dental therapists in the school-based program had reached 96% of elementary and 67% of secondary school

children.⁵³ The oral health status of children aged 12 years in the urban and rural areas constituting Kuala Lumpur was investigated in 2010; 94% of the children in urban schools and 87% of the children in rural schools had no untreated carious lesions.⁵⁴ The school-based program resulted in a significant reduction in disparities in oral health between the economically advantaged and disadvantaged children that previously existed because of the high cost of private dental care that was beyond the reach of the poor. Implementation of the systematic, incremental school-based dental care system, operated by dental therapists since 1985, has resulted in a sharp decline in decayed teeth and a corresponding increase in restored teeth among children.^{53,55} Of those given care, 97% of elementary and 91% of secondary school children were rendered "orally fit."⁵³

US Private Practice Model

Dental caries affects 58.6% of children aged 5 to 17 years and is therefore the nation's most common childhood disease, 5 times more common than childhood asthma and 7 times more common than hay fever.⁵⁶ Dental care is the most prevalent unmet health need among children.⁵⁷ Eighty percent of dental disease is found in 20% to 25% of children—approximately 18 million children—and these children are primarily from low-income African American, Hispanic, and American Indian/Alaskan Native families.⁵⁸ Children lose more than 51 million hours of school time each year because of dental problems,⁵⁹ and poor children experience nearly 12 times as many restricted-activity days because of dental disease as do children from economically advantaged

backgrounds.⁶⁰ A 2012 report in the *American Journal of Public Health*⁶¹ found that children with toothaches were almost 4 times more likely to have a low grade-point average and that parents of children missed 2.5 days of work annually because of their children's dental problems.

A significant number of carious teeth in children are not restored, and the number restored declines with an increase in the level of poverty.⁶² Children of families whose income is below 200% of the federal poverty level are 3 times more likely to have unmet dental care needs than are those whose income is above 200% of the federal poverty level.⁵⁷

In 2004, 25% of children younger than 6 years had received a dental visit. For children aged 6 to 12 years, 59% had received a dental visit.⁶³ In 2005, 46.5% of children aged 0 to 17 years had at least 1 dental visit that year. Thus 38.5 million children, the majority of US children, did not have a dental visit that year.⁶⁴ A Centers for Medicare and Medicaid Services study in 2009 found that only 40% of children enrolled in Medicaid or the Children's Health Insurance Program had received dental services in the previous year.⁶⁵

Dye et al.⁶⁶ reported 2004 data indicating that 28% of children aged 24 to 60 months had early childhood caries, an increase of 4% from 1988–1994 to 1999–2004. Caries in children aged 2 to 4 years increased from 18% to 25% during that period, as did the prevalence of untreated tooth decay in that age group, from 18% to 24%. Dental caries in the primary dentition of children aged 2 to 11 years increased significantly between 1988 and 1994 and 1999 and 2004 from 1.39 dft to 1.58 dft. The percentage of

unfilled primary teeth remained constant during the time period at 23%. The DMFT for children aged 12 to 15 years in 2004 was 2.55, with 42.7% being caries-free. Caries was untreated in 19.76% of these adolescents. Data from the National Health and Nutrition Survey, 2009–2010, indicated that approximately 1 in 4 children living in poverty aged 3 to 5 years and 6 to 9 years had untreated caries.⁶⁷

COST OF CARE

School-based dental care programs around the world are usually administered by a public health service and supported with public funds. The cost of care per child can be calculated on the basis of the number of children enrolled in the program and the total costs (direct and indirect) of operating the program.

In 2011, the cost to the New Zealand government for the school dental service was US \$99 per child for comprehensive preventive and restorative care.⁶⁸ By contrast, the cost of an initial diagnostic appointment, with no treatment, by a New Zealand dentist in the private sector was US \$102.⁶⁸

Australian studies documented that the savings from treating children in the school dental service compared with private practice ranged from 14% to 20%.^{69,70} In 1996, the savings in 1 state was much greater: A\$265.00 (US \$276.00) per child treated in private practice versus A\$52.49 (US \$54.62) per child treated by the school dental service.⁷⁰ In Western Australia, the cost of care per child in 2001 was A\$65.70 (US \$68.36).⁷¹

The estimated cost of care per child per year in Hong Kong was US \$78 in 2011–2012, based on the

fee charged to foreign nationals to enroll a child in the school dental service (E. C. M. Lo, personal communication, August 2012).

In 2011, the Canadian Center for Policy Alternatives analyzed the financing of the Saskatchewan school-based program of the 1980s.⁷² The report concluded that if the program existed throughout Canada today, the inflation-adjusted cost for comprehensive preventive and restorative care would be Can\$176.25 (US \$172.88) per child in contrast to a general dentist's fee in the private sector of more than Can\$225 (US \$220.70) for 1 pulpotomy and stainless steel crown. The estimated cost for such a public, school-based program using dental therapists to treat all of Canada's children aged 5 to 14 would have been Can\$560 million (US \$549 million), which the report indicated would be a dramatic savings over current expenditures in dental care for children.

The United States Agency for Health Care Research and Quality reported in the Medical Expenditure Panel Survey that dental expenditures in 2010 for children younger than 5 years were \$223; for children aged 5 to 17 years, \$308.⁷³ The \$308 represented a decline from the 2004 data of \$310⁷⁴ (\$365 in 2011 dollars). In 2010, Beil and Rozier reported on the average dental expenditures per child using 2004 data, based on whether or not the child had been advised to visit the dentist by their primary health care provider.⁷⁵ The costs for children aged 2 to 5 years who had been advised to seek care was \$187; for those not advised, \$204. For elementary school children aged 6 to 11 years who were advised to seek care, the costs were \$504 per child, compared with \$397 for

those not advised to do so. For comparison to the previously cited international elementary school programs, in 2011 dollars these costs were \$593 and \$466, respectively.

REVIEW

A crisis exists in the oral health care delivery system for children in the United States, a crisis that is the result of a complex group of circumstances. Many dentists do not provide care for children in their practices. Many who do provide care for children do not accept insurance provided by Medicaid and the Children's Health Insurance Program. Yet, in 2014, the majority of US children will be eligible for public funding for their dental care at a fee level that many private practitioners reject. The American Dental Association has argued that the problem of access to care could be resolved by dentists if only reimbursement fees for children with public insurance were increased.⁷⁶ However, the evidence to support this claim is scant,⁷⁷ and increased fees are not realistic to expect considering the nation's budgetary problems. The burden of dental disease is greater among children from economically disadvantaged families in which the stressors of living in poverty frequently reduce dental care to a lower priority. Furthermore, barriers such as transportation, distance, and child care all have a negative impact on economically disadvantaged children receiving care.^{78–80}

In spite of the barriers, dentistry, as a privileged profession granted a virtual monopoly to practice, has the social and moral obligation to address the problem of access to care, particularly for children. Forty years ago, in 1972, James Dunning, distinguished

public health dentist and dean of the Harvard School of Dental Medicine, advanced a solution that is relevant to access today. He said, "Any large scale incremental care plan for children, if it is to succeed, must be brought to them in their schools."^{81(p625)} The school-based programs in the 6 countries we have reviewed in this article have documented the effectiveness of dental therapists caring for children in schools. The literature has indicated that dental therapists provide quality care. Participation rates of elementary school children in the international school-based programs cited are between 82% and 98%. These rates contrast starkly with those for the US private practice model, in which approximately 50% of elementary school children are seen by a dentist in any 1 year, with a lower rate of 40% for children with public insurance. In New Zealand, almost 60% of children aged 2 to 4 years were seen by a school-based dental therapist in 2009, whereas in the United States only 28% of children aged 2 to 4 years had a dental appointment in 2007.⁸²

The oral health of children in countries with school-based programs is better than that of children in the United States. In New Zealand, 51.6% of children aged 12 to 13 years in 2009 were caries-free; the DMFT was 1.3. In Hong Kong, 62% of children aged 12 to 13 years were caries-free in 2001; the DMFT was 0.8. In Singapore, the DMFT of children aged 12 years was 0.7. In the United States, 42.7% of children aged 12 to 15 years were caries-free in 2004; the DMFT was 2.55.

Countries with school-based programs staffed by dental therapists have a better record of caring for their children than does the United States. The DMFT of Hong

Kong children was 0.8, with 0.6 of the index being filled teeth. Malaysia reported 97% of its elementary school children receiving care were rendered orally fit. Singapore reported that 89% to 96% of elementary school children were dentally fit. In New Zealand, 81.7% of elementary children with caries have had the affected teeth restored. John Walsh, dean of New Zealand's dental school at the University of Otago, compared and contrasted the ratio of filled to unfilled teeth and designated this ratio a "care index."³³ The care index for New Zealand children in 1964 was 72%, versus 23% for the US children, indicating their higher levels of untreated decay.³³ In 1994, the care index in the United States had improved to 72.3% for children at 300% of the federal poverty level but was only 48.7% for children at 100% of the poverty level.⁶² In 2004, the index was 77.1% for elementary school children, aged 5 to 11 years.⁶⁷ The index falls with increasing levels of poverty; for children at 100% of poverty the care index was 67.5%. Walsh claimed that the care index provides a convenient measure of the effectiveness of a country in treating dental caries. He suggested that the extent to which a nation meets the needs of its children is largely dependent on the degree of cooperation that exists between the dental profession and the government. In addressing the American College of Dentists in 1964, Walsh said, "The worthiness of a society can be evaluated in terms of its concern for and care of the health of its children."^{33(p151)}

He went on to quote President John F. Kennedy: "Children may be the victims of fate; they must never be the victims of neglect."

The cost of dental care for children in the United States

exceeds by several times that of cited international school programs. If publically funded, school-based clinics staffed by dental therapists existed in the United States, not only would access to primary dental care be available for essentially all children, versus the approximately one half of children who receive annual care currently, but the cost of dental care for children would be significantly reduced.

Such savings in costs can be partially explained by the salaries or incomes of the practitioners providing care. Dental therapists' annual salaries are, for New Zealand, US \$30 000 to \$45 000⁸³; South Australia, US \$60 000 (C. Klempster, personal communication, August 2012); and Hong Kong, US \$60 000 (E. C. M. Lo, personal communication, August 2012). In Malaysia, salaries of therapists are approximately 50% of those of dentists (N. Jaafar, personal communication, August 2012). These salaries are in contrast to the 2009 incomes of general dentists and pediatric dentists in the United States: \$212 920 and \$312 660, respectively.⁸⁴

A public school-based system of care does not exist in the United States, and capitalization and training costs are not included in the preceding cost savings estimates. However, the costs of capitalizing an infrastructure for such a system would be recovered rapidly were such an investment to be made, with significant savings in the cost of dental care for children over the long term. With the majority of America's children now eligible for primary dental care through Medicaid/CHIP, it is prudent that these funds be expended as economically as possible in publically funded school-based programs. Ultimately, the cost

of ensuring oral health for US children will depend on comprehensive public health programs of prevention, which school-based dental therapists could effectively lead.

CONCLUSIONS

The global literature has documented that dental therapists practicing in public, school-based programs provide quality care for children, improve access to care with effective outcomes, and do so economically. In the United States, no studies on the quality of care provided for children by dentists are available. Many US children face major barriers to receiving care, resulting in poor access and thus in less-than-desirable oral health outcomes and outcomes significantly less than those of countries with school-based programs using dental therapists. The cost of providing care in a market-driven economy of dentists in private practice is excessively expensive in comparison with the costs associated with international publicly funded, school-based programs.

Leaders in formulating public policy, federal and state lawmakers, and leaders in the profession of dentistry have an obligation to consider implementing international best practices to ensure that all US children are able to gain the benefits of oral health at a cost that is economical and affordable. ■

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